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㊹発明の名称 紙幣識別方法

㉑特願 昭59-70999
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明細書の浄書(内容に変更なし)

明 細 書

1.発明の名称 紙幣識別方法

2.特許請求の範囲

(1) 紙幣を複数のゾーンに分け、各ゾーン毎の検出データを前記各ゾーンに対応して予め求められている基準データと比較し、前記各ゾーンにおける比較結果に基づいて前記紙幣を識別する紙幣識別方法において、前記基準データを前記紙幣の表裏、向き及び識別時の位置ずれに対応して複数個設定すると共に、紙幣1枚に対して前記各ゾーンのデータを総計し、その総計値に対する比率値で基準パターンデータとして記憶しておき、前記検出データの総和値を求めると共に、この総和値に対する比率値を検出パターンデータとして計算し、前記基準パターンデータと検出パターンデータとを比較して紙幣識別を行なうことを特徴とする紙幣識別方法。

(2) 紙幣を複数のゾーンに分け、各ゾーン毎の検出データを前記各ゾーンに対応して予め求められている基準データと比較し、前記各ゾーンにおける比較結果に基づいて前記紙幣を識別する紙幣識別方法において、前記基準データを前記紙幣の表裏、向き及び識別時の位置ずれに対応して複数個設定すると共に、紙幣1枚に対して前記各ゾーンのデータを総計し、その総計値に対する比率値で基準パターンデータとして記憶しておき、前記検出データの総和値を求めると共に、この総和値に対する比率値を検出パターンデータとして計算し、前記検出パターンデータが前記基準パターンデータの許容範囲内にあるか否かを判断し、前記各ゾーン毎に前記基準パターンデータと前記検出パターンデータとの差の絶対値を加算計算して総計し、この加算計算の総計値が許容値よりも小さいか否かを判断して紙幣識別を行なうことを特徴とする紙幣識別方法。

(3) 前記比較判断において複数個の判断結果が生じた場合、前記距離計算の総計値の最小のデータに従って紙幣識別を行なう特許請求の範囲第2項に記載の紙幣識別方法。

3.発明の詳細な説明

(発明の技術分野)

この発明は紙幣識別方法に関し、特に多金種の紙幣をその搬送状態(表裏、向き、左右の位置ずれ等)に影響されずに真偽、金種を識別する紙幣識別方法に関する。

(発明の技術的背景とその問題点)

紙幣の識別方法には種々の方法があるが、一例として、紙幣が移動する面に光センサや磁気センサ等を配置して、紙幣が通過する際の所定移動量毎に、即ち紙幣をいくつかのゾーンに区分して光センサや磁気センサの出力信号を取出し、それを予め求められている基準値と比較し、各ゾーンの比較結果により紙幣の真偽、金種を識別するものがある。しかし、この方法は磁気センサ、光センサの取付位置には変更を加えないで、識別プログラムのソフトウエアの方で対処しなければならず、この場合も基準パターンの作成は極めて難しいことになる。

(発明の目的)

この発明は上述のような事情からなされたものであり、汚れや疲労等に対しても通過率が下がらず、非常に多金種の紙幣について、その搬送状態(表裏、向き、位置ずれ等)に影響されることもなく、高い通過率を保持できる紙幣識別方法を提供することを目的としている。

(発明の概要)

この発明は、紙幣を複数のゾーンに分け、各ゾーン部の検出データを各ゾーンに対応して予め求められている基準データと比較し、各ゾーンにおける比較結果に基づいて紙幣を識別する紙幣識別方法に関するもので、基準データを紙幣の表裏、向き及び識別時の位置ずれに対応して複数個設定すると共に、紙幣1枚に対して各ゾーンのデータを総計し、その総計値に対する比率値で基準パターンデータとして記憶しておき、検出データの総和値を求めると共に、この総和値に対する比率値を検出パターンデータとして計算し、上記基準パターンデータと検出パターンデータとを比較して紙幣識別を行なうようにしたものである。また、他の発明では、基準データを前記紙幣の表裏、向き及び識別時の位置ずれに対応して複数個設定すると共に、紙幣1枚に対して各ゾーンのデータを総計し、その総計値に対する比率値で基準パターンデータとして記憶しておき、検出データの総和値を求めると共に、この総和値に対する比率値を検出パターンデータとして計算し、上記検出パターンデータが上記基準パターンデータの許容範囲内にあるか否かを判断し、各ゾーン部に基準パターンデータと検出パターンデータとの差の絶対値を距離計算して総計し、この距離計算の総計値が許容値よりも小さいか否かを判断して紙幣識別を行なうようにしている。

(発明の実施例)

第１図はこの発明方法を実現する装置の一例を示すものであり，紙幣１は識別のために搬送機構（図示せず）で図示Ｑ方向に搬送され，識別部DSに送られるようになっている。識別部DSには紙幣１の斜行や長さ等を検出するためのフォトセンサP1～P4が２個ずつ並設されると共に，紙幣１の磁気パターンを検出するための磁気センサM1～M3が３個横設されている。そして，磁気センサM1～M3の検出信号はそれぞれ同一構成の回路に入力されるようになっており，たとえば磁気センサM1の検出信号DMは差動増幅器２で増幅され，その増幅信号ASが全波整流の整流器３及びバンドパスフィルタ４を経て信号包絡線APに波形変換され，微分器５で微分された後にマルチプレクサ６を経てAD変換器７でディジタル化される。また，フォトセンサP1～P4の検出信号はそれぞれ波形整形回路11～14で波形整形され，検出信号D1～D4として得られる。さらに，識別部DSの搬送機構には速度に応じたパルスを出力するフォトインタラプタ15が設置されており，波形整形回路16で波形整形されてクロックパルスCPとして出力される。上述のように，AD変換器７から出力されるディジタル値DAI，波形整形回路11～14から出力される検出信号D1～D4及び波形整形回路16から出力されるクロックパルスCPは，マイクロプロセッサ等のCPU20，ROM21 及びRAM22 で成る制御系にバスライン23を介して入力されるようになっている。CPU20 が全体の制御を行ない，ROM21 には後述するようなプログラム及び基準データが格納されており，CPU20 は積分器５及びマルチプレクサ６をタイミング制御する。

ここで，磁気センサM1～M3は同一構造であり，第２図に示すようにコア101 の中央部に巻回された１次巻線102 に正弦波103 を印加して交流磁界を形成し，コア101 の端部に巻回された２次巻線104 で紙幣１の面とシールドされている反対側の面との差の出力DMを取出すようにしたものである。なお，この磁気センサの出力DMは，紙幣１の磁気インクが全くないときでも微小な正弦波信号が出力されるようになっており，この磁気センサでは磁気インクの濃度が一様の部分においても対応した出力が得られる。

一方，第３図(A) 及び(B) はこの発明における紙幣１のゾーンの分割の様子を示すものであり，紙幣１のQ方向への搬送に対して磁気センサM1～M3で３つのストリップゾーンZ1～Z3に分けると共に，紙幣１の搬送量に応じて各ストリップゾーンZ1～Z3をそれぞれ更に４分割し，全体として＊１～＊12の12個のゾーンに区画している。このようにして区画されたゾーン＊１～＊12に対して，この発明では各ゾーン毎に磁気センサM1～M3で検出される検出データの平均値ａを求めると共に，許容範囲を定める偏差ｄを設定し，第４図のような形態で全紙幣にROM21 に格納しておく。この場合，平均値a1～a12はゾーン＊１～＊12の検出データを統計し，その統計値に対する比率に換算した値となっており，複数枚の標準紙幣を複数回検出してその平均をとる。また，各ゾーン＊１～＊12の偏差d1～d12 は試行錯誤的に設定されるものであり，検出データをｘとしたときに ａ-ｄ≦ｘ≦ａ+ｄ の範囲に入っていればOKとするものである。さらに，有効距離edは，各ゾーン毎に標準パターンの平均値ａと検出データｘとの差を求め，その絶対値を加算した距離計算CND が越えてはならない値であり，平均値ａからのずれの範囲を大きくしないようにしている。この有効距離edも，全紙幣に試行錯誤的に設定されるものである。

紙幣１の識別搬送時に横方向（Ｑと直角方向）にずれることも考えられるので，この発明では第３図(B) に示すようにストリップゾーンZ1～Z3を更にそれぞれ横方向に５区画に分け，紙幣１が横方向に位置ずれを生じても正しく識別できるようにしている。すなわち，ラインCは紙幣１が搬送路の中央部を通る時の検出位置を，ラインSRは少し右側へずれた時の検出位置を，ラインLRは大きく右側へずれた時の検出位

第1を検知するまでの間のメカクロック数により斜行量を検出することができる。そして、この斜行量が予め定められた許容値を越えた場合、即ち傾きの程度が大きい場合には識別動作は行なわず、別途排除したり、または復帰させて元の位置へ戻すように再搬送しても良い。

また、傾きはあるが許容値以内ならば識別を行なうが、磁気センサM1～M3からの積分値の読込タイミングは、傾き量によって異なってくる。

上述のようにしてフォトセンサP1～P4により紙幣1の長さℓが検出されると（ステップS1）、第5図に従って大まかに金種が特定される。各金種について表裏、向き、位置ずれにより各々20個の基準パターンがあり、全てにパターン番号が付せられており、長さ検出により比較すべきパターン番号の最初の値n1と最後の値n2を選択する（ステップS2）。たとえば長さ検出により80mmとされた場合、パターン番号＊101～＊120を選択する。そして、長さ検出後、上述したような全ゾーンのデータが得られると（ステップS3）、ゾーン＊1～＊12の検出データX1～X12の総和が1となるように、各検出データの比を算出する。例えばゾーン＊1の検出データX1はX1/(X1+X2+…+X12)で比率が計算されて、検出パターンデータとしてx1を得る。同様にして、ゾーン＊2～＊12の比率を示す検出パターンデータx2～x12を得、RAM22に記憶する（ステップS4）。次に、この各検出パターンデータxi(i=1～12)とステップS2で選択された最初の基準パターン番号のデータとの比較を行なう（ステップS5～S9）。例えば現行の五千円券ならパターン番号＊101のデータを読出し、まず a1-d1≦x1≦a1+d1 が満たされるか否かを判断し、OKならば次にゾーン＊2の比較を行ない、a2-d2≦x2≦a2+d2 が満たされるか否かを判断する。このようにして全てのゾーン＊1～＊12がOKとなったとき、次に平均値aiからの距離$\sum_{i=1}^{12}|ai-xi|$(=CHD)を計算し（ステップS10）、パターン番号＊101の有効距離edと比較する（ステップS11）。そして、CHD＜edならパターンが一致しているとしてパターン番号＊101とCHDの値をRAM22に記憶する（ステップS12）。

ここに、距離CHDは検出パターンデータxiが基準パターンの平均値aiとどれ位の隔たりがあるかを見るためのパラメータであり、全てのゾーンにおいて検出パターンデータxiが基準パターンの平均値aiと一致するならば距離は0となる。各ゾーンにおける判断は ai-di≦xi≦ai+di を満たすか否かで行なうが、たとえ全ゾーンでOKとなっても、各ゾーンで上限、下限ぎりぎりのところでパスしているようなものは距離CHDが大きくなり、元の基準値との隔たりは大きいものと考え排除するのである。

上述の例でパターン番号＊101を記憶すると、次のパターン番号＊102の基準パターンデータを読出して比較し（ステップS13、S14）、パターン番号＊120まで順次比較を行なう。そして、全てのパターン番号の比較が済むと、全ての条件がOKとして記憶登録されたパターン番号の数を判断し（ステップS15）、もし全然なければ偽券と判断する（ステップS18）。また、パターン番号が複数あるときには距離CHDの値を各々比較し、その値が最小のもののパターン番号をRAM22に記憶し（ステップS16、S17）、この記憶されたパターン番号により紙幣の金種、向き等を1つに特定する（ステップS18）。もし登録パターン番号が1つだけなら、その番号により金種、向き等を特定することになる。

なお、上述では検出センサとして磁気センサを用いた例を説明したが、光センサを用いても同様に識別可能である。また、上述では紙幣をゾーン＊1～＊12に分割しているが、分割数は任意である。

（発明の効果）

以上述べたように、この発明では検出データをそのまま基準データと比較しないで、検出データ相互間の比をとって比較するようにしているので、汚れや疲労等に殆んど影響されること

はない。また、各ゾーンにおける検出パターンデータと基準パターンデータの平均値との差の累計値をとっており、その値の小さいものの方のパターンを優先させているので、多金種の紙幣をその搬送状態に影響されることなく、通過率を高くして識別することが可能である利点を有する。

4.図面の簡単な説明

第1図はこの発明方法を適用した装置の一例を示す構成図、第2図はこの発明に用いる磁気センサの一例を示す構造図、第3図(A)及び(B)はそれぞれこの発明のゾーン区画を説明する図、第4図及び第5図はそれぞれこの発明の基準パターンを説明するための図表、第6図はこの発明の動作例を示すフローチャート、第7図(A)～(C)は磁気センサの動作例を示すタイミングチャートである。

1…紙幣、2…自動増幅器、3…整流器、4…バンドパスフィルタ、5…微分器、6…マルチプレクサ、M1～M3…磁気センサ、P1～P4…フォトセンサ。

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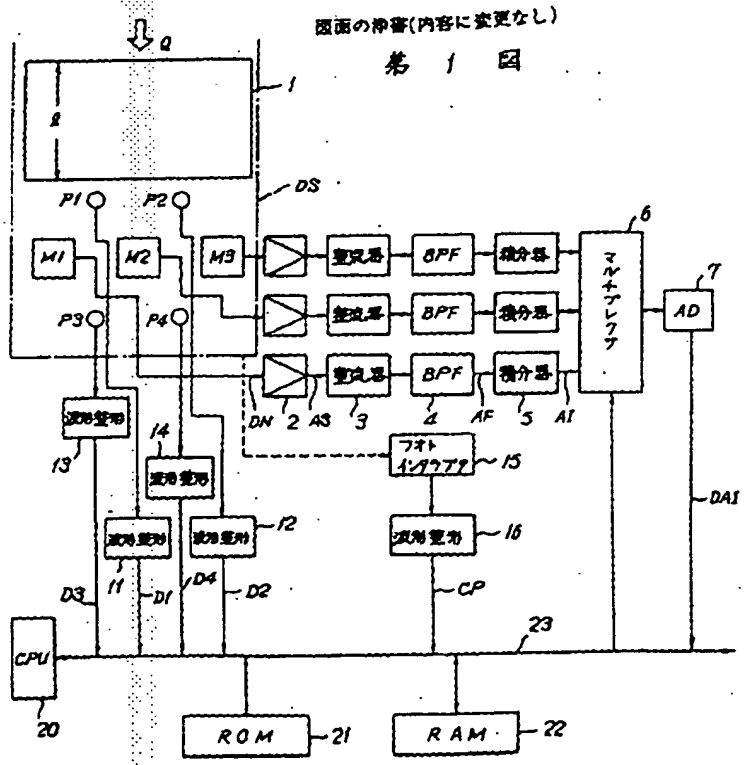
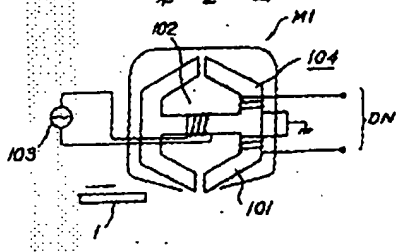
図面の浄書(内容に変更なし)

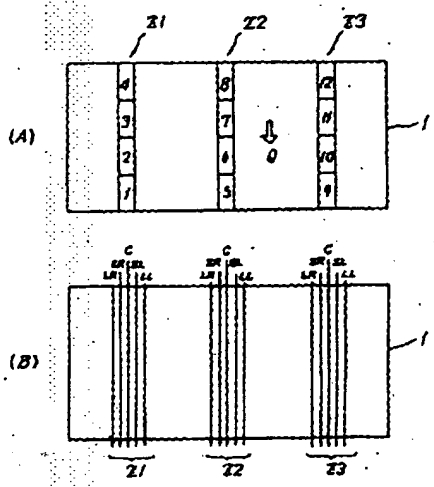
第　1　図



第 2 図



第 3 図



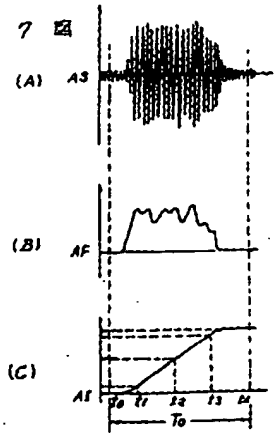
第 4 図

a_1	ゾーン#1の平均値
d_1	ゾーン#1の偏差
a_2	ゾーン#2の平均値
d_3	ゾーン#2の偏差
a_3	ゾーン#3の平均値
⋮	⋮
a_{11}	ゾーン#11の平均値
d_{11}	ゾーン#11の偏差
a_{12}	ゾーン#12の平均値
d_{12}	ゾーン#12の偏差
c_d	有効距離

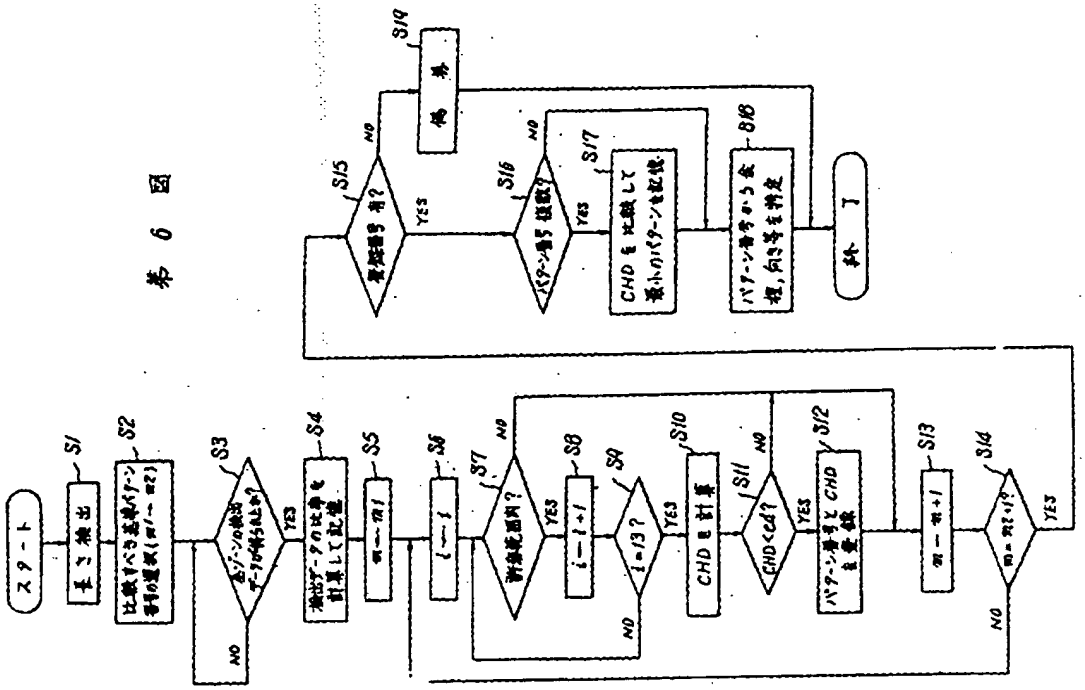
第 5 図

紋様の長さ(mm)	金　額	パターン番号
72	現行　五百円	#1 ～ 20
76	現行　千　円	#21 ～ 40
	改訂　千　円	#41 ～ 60
	改訂　五千円	#61 ～ 80
	改訂　一万円	#81 ～ 100
80	現行　五千円	#101～ 120
84	現行　一万円	#121 ～ 140

第 7 図



第6図



手続補正書（方式）

昭和59年8月14日

特許庁長官　志賀　学　殿

1.事件の表示
　昭和59年特許願第 70883号

2.発明の名称
　縦隔識別方法

3.補正をする者
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5.補正命令の日付
　昭和59年7月11日
　（発送日　昭和59年7月31日）

6.補正の対象
　明細書及び図面

方式審査

7.補正の内容
(1) 願書に最初に添付した明細書の浄書・別紙のとおり（内容に変更なし）補正する。
(2) 本願添付の図面を別紙のとおり補正する。

(19) Japan Patent Office
(12) Public Patent Disclosure Bulletin
(11) Public Patent Disclosure Bulletin No. S60-215293
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(54) A method for discriminating bank notes

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SPECIFICATION

1. Title of the Invention: A method for discriminating paper notes

2. Scope of Patent Claims

(1) A method for discriminating paper notes, being a method for discriminating paper notes wherein the paper notes are separated into a plurality of zones, the detection

data of each zone is compared with the standard data that has been determined beforehand in response to the above-mentioned detection data of each zone, and the above-mentioned paper notes are discriminated based on the results of comparison in each of the above-mentioned zones, wherein discrimination of paper notes is performed as follows: several items of the above-mentioned standard data are set in response to whether or not the above-mentioned bills are face up or down or have slipped out of position, and to their orientation, and in addition the data for each of the above-mentioned zones is aggregated for one paper note, and is recorded as the standard pattern data by a proportional value relative to that aggregate value; then, the total value of the above-mentioned detection data is determined, and in addition the proportional value relative to this total value is calculated as detection pattern data, and a comparison is made between the above-mentioned standard pattern data and the detection pattern data.

(2) A method for discriminating paper notes, being a method for discriminating paper notes wherein the paper notes are separated into a plurality of zones, the detection data of each zone is compared with the standard data that has been determined beforehand in response to the above-mentioned detection data of each zone, and the above-mentioned paper notes are discriminated based on the results of comparison in each of the above-mentioned zones, wherein discrimination of paper notes is performed as follows: several items of the above-mentioned standard data are set in response to whether or not the above-mentioned bills are face up or down or have slipped out of position, and to their orientation, and in addition the data for each of the above-mentioned zones is aggregated for one paper note, and is recorded as the standard pattern data by a proportional value relative to that aggregate value; then, the total value of the above-mentioned detection data is determined, and in addition the proportional value relative to this total value is calculated as detection pattern data, a determination is made whether or not the above-mentioned detection pattern data falls within a tolerable range of the above-mentioned standard pattern data, the absolute value of the difference between the above-mentioned standard pattern data and the above-mentioned detection pattern data is aggregated by a distance calculation for each of the above-mentioned zones, and a determination is made whether or not the aggregate value of the distance calculation is smaller than the tolerable value.

(3) The method for discriminating paper notes described in Claim 2 of the Scope of Patent Claims, wherein discrimination of paper notes is performed in accordance with the data of the minimum of the aggregate value of the above-mentioned distance calculation, in the event that several kinds of determination results arise in the above-mentioned determination by comparison.

3. Detailed Explanation of the Invention

(Field of Industrial Application)

This invention relates to a method for discriminating paper notes, and relates in particular to a method for discriminating paper notes that discriminates the genuineness and the face amount of various denominations of paper notes without being affected by the state of conveyance thereof (face up or down, orientation, slippage out of position, etc.).

(Prior Art of the Invention and the Problems Thereof)

There exist a variety of methods for discriminating paper notes. As one example, there is a method wherein optical sensors or magnetic sensors are positioned on the

surface on which the paper notes move, sorting is done for each prescribed amount of moving paper notes, that is, the paper notes are sorted in several zones, when they pass through, a comparison is carried out between this and a standard value that has been determined in advance, and discrimination of the genuineness and the face amount of the paper notes is performed based on the results of the comparison of each zone. However, since this method discriminates paper notes by comparing the detection data from separate sensors as is with the standard data, there is the drawback that it is common for a genuine paper note to be judged to be fake in the case of soiled paper notes and paper notes with a high degree of wear and tear, and that the pass rate in paper note discrimination is poor.

Additionally, to date there have only been four kinds of paper notes subjected to discrimination (ten thousand yen notes, five thousand yen notes, one thousand yen notes and five hundred yen notes). Even if one takes into consideration such factors as whether or not the paper notes are face up or down and whether they have slipped out of position during conveyance, and their orientation, etc., the preparation of a standard pattern to be determined in advance has been comparatively easy, but since three new kinds of paper notes of different size, namely the new-style ten thousand yen notes, five thousand yen notes and one thousand yen notes, began to circulate in Japan in 1984 **[?; partly illegible]**, the number of the kinds of paper notes to be discriminated has now risen to seven in all. If one takes into consideration the factors as whether or not the paper notes are face up or down and whether they have slipped out of position during conveyance, and their orientation, etc., for all seven kinds of paper notes, it is clear that the preparation of a standard pattern is extremely troublesome, and even assuming that it is possible to prepare this, mistaken discrimination of paper notes is absolutely impossible, so the result is that the pass rate instead declines. **[TN: There is something missing or incorrect in the Japanese for this last sentence.]**

Moreover, in order to make it possible for the discrimination devices present in the current market to cope easily when the new paper notes were circulated, discrimination program software was necessary to deal with this without making any alterations to the installed devices like the magnetic sensors and optical sensors, and the preparation of a standard pattern is extremely difficult in this case as well.

(Purpose of the Invention)

This invention was created out of consideration of circumstances like those described above, and takes as its purpose the provision of a method for discriminating paper notes that can maintain an extremely high pass rate that does not decline due to such factors as soiling and wear and tear, without being affected by the state of conveyance of paper notes of multiple denominations (face up or down, orientation, slippage out of position).

(Summary of the Invention)

This invention relates to a method for discriminating paper notes wherein the paper notes are separated into a plurality of zones, the detection data of each zone is compared with the standard data that has been determined beforehand in response to the above-mentioned detection data of each zone, and the above-mentioned paper notes are discriminated based on the results of comparison in each of the above-mentioned zones. In this method, the discrimination of paper notes is performed as follows: several items of the above-mentioned standard data are set in response to whether or not the above-

mentioned bills are face up or down or have slipped out of position, and to their orientation, and in addition the data for each of the above-mentioned zones is aggregated for one paper note, and is recorded as the standard pattern data by a proportional value relative to that aggregate value; then, the total value of the above-mentioned detection data is determined, and in addition the proportional value relative to this total value is calculated as detection pattern data, and a comparison is made between the above-mentioned standard pattern data and the detection pattern data. In addition, discrimination of paper notes is performed as follows: several items of the above-mentioned standard data are set in response to whether or not the above-mentioned bills are face up or down or have slipped out of position, and to their orientation, and in addition the data for each of the above-mentioned zones is aggregated for one paper note, and is recorded as the standard pattern data by a proportional value relative to that aggregate value; then, the total value of the above-mentioned detection data is determined, and in addition the proportional value relative to this total value is calculated as detection pattern data, a determination is made whether or not the above-mentioned detection pattern data falls within a tolerable range of the above-mentioned standard pattern data, the absolute value of the difference between the above-mentioned standard pattern data and the above-mentioned detection pattern data is aggregated by a distance calculation for each of the above-mentioned zones, and a determination is made whether or not the aggregate value of the distance calculation is smaller than the tolerable value.

(Embodiment of the Invention)

Figure 1 shows one example of a device that realizes the method of this invention. The device is configured such that paper notes 1 are conveyed in the Q direction indicated in the figure with the conveyance machine (not shown in the figure) for purposes of discrimination, and are sent to the discrimination part DS. Four photosensors P1-P4 are provided in two groups of two in proximity in a row arrangement on the discrimination part DS in order to detect the slantward movement, length, etc., of the paper notes 1. In addition, three magnetic sensors M1-M3 for detecting the magnetic pattern of the paper notes 1 are provided laterally. Then, the device is configured such that the detection signals of the magnetic sensors M1-M3 are respectively provided as input to circuits with the same composition. For example, the detection signal DN of the magnetic sensor M1 is amplified by the differential amplifier 2, that amplified signal AS passes through the rectifier 3 for full wave rectification and the hand pass filter 4 and is waveform converted into a signal envelope AF, and after it is integrated by an integrator 5 is passes through a multiplexer 6 and is digitalized by an AD converter 7. In addition, the detection signals of the photosensors P1-P4 are respectively waveform shaped by the waveform shaping circuits 11-14, and are obtained as detection signals D1-D4. Moreover, the photointegrator 15, which outputs a pulse in accordance with the speed, is connected to the conveyance machine of the discrimination part DS, and waveform shaped by the waveform shaping circuit 18 and is provided as output as a clock pulse CP. As described above, the device is configured such that digital signal DA1 provided as output from the AD converter 7, the detection signals D1-D4 provided as output from the waveform shaping circuits 11-14 and the clock pulse CP provided as output from the waveform shaping circuit 18 are provided as output by way of the bus line 23 to the control system, which is composed of the CPU 20, ROM 21 and RAM 22 of a microprocessor, etc. The CPU 20 exercises overall control, and as described below the

programs and standard data are stored in the ROM 21. The CPU20 performs timing control for the integrator 5 and the multiplexer 6.

Here, the magnetic sensors M1-M3 have the same construction. As shown in Figure 2, these have been configured such that an alternating-current magnetic field is formed by impressing a sine wave on the primary winding 102 that has been wound around the central part of the core 101, and output DM of the difference between the surfaces of the paper notes 1 and the surfaces of the opposite sides, which have been shielded, is extracted by the secondary winding 104, which is wound around the tip of the core 101. They have further been configured so that a minute **[?; partly illegible]** sine wave signal is provided as output even when there is absolutely no magnetic ink on the paper notes 1. Output is obtained by these magnetic sensors even for those parts for which the concentration of the magnetic ink is uniform.

On the other hand, Figure 3 (A) and (B) show the state of the division into zones of the paper notes 1 in this explanation. It is divided into 3 strip zones Z1-Z3 by the magnetic sensors M1-M3 relative to the conveyance of the paper notes 1 in the Q direction. In addition, each of these strip zones Z1-Z3 have further been respectively divided in four in accordance with the conveyance length of the paper notes 1, so that it has been divided into a total of 12 zones numbered #1 to #12. As a consequence, in this invention the mean values a for the detection data that is detected by the magnetic sensors M1-M3 is determined for each zone, relative to the zones #1 - #12 into which the device is divided. In addition, the deviation d that establishes the tolerable range is set, and is stored in the ROM 21 for each type of paper note in the form shown in Figure 4. In this instance, the mean values a1-a12 calculate the detection data of the zones #1 - #12, and are values that have been converted into a proportion relative to the aggregate value thereof. The mean is taken by detecting several times the several standard **[?; partly illegible]** paper notes. In addition, the deviations d1-d12 of each zone #1 - #12 are set by trial and error, but it is OK if they fall in a range where $a - d \leq x \leq a + d$ when the detection data is taken to be x. Moreover, the effective distance ed determines the difference between the mean value a of the standard pattern for each zone and the detection data x, and this is a value that the distance calculation CHD, to which the absolute value thereof is added, cannot exceed, and is such that the range of the deviation from the mean value a is enlarged. This effective distance ed is also set by trial and error for each kind of paper note.

Since the possibility of slippage in a lateral direction (the direction orthogonal to Q) at the time of the conveyance of the paper notes 1 for discrimination has been contemplated, in the present invention as shown in Figure 3 (B), the strip zones 21-23 have been divided respectively into five sections in a lateral direction, so that it is possible to discriminate the paper bills 1 accurately even when these have slipped out of place in a lateral direction. In other words, the line C indicates the detection position when the paper bills pass through the central part of the conveyance path, the line SR indicates the detection position when they deviate slip to the right, the line LR indicates the detection position when they deviate greatly to the right, the line SL indicates the detection position when they deviate slip to the left, and the line LL indicates the detection position when they deviate greatly to the left. Hen the detection zones are divided in this manner, four patterns are obtained for one kind of paper note based on whether or not it is face up or down and its orientation. Since there are five patterns for

slippage out of position as shown in Figure 3 (B) for each of these four patterns, a total of 20 patterns is necessary. This means that a grand total of 140 patterns are needed to discriminate all seven kinds of paper notes. However, in the event that the width of the conveyance path is made the maximum width of the paper notes to be discriminated, this number becomes smaller than 140 overall, due to the facts that there is no slippage out of position in connection with the paper notes with the maximum width, and that the patterns overlap for specific kinds of paper notes. Thus, 20 standard patterns like those shown in Figure 4 are determined for each of the various kinds of paper notes, and are stored in the ROM 21. In this invention as shown in Figure 5, four large divisions are made based on the length l of the paper notes 1, and the paper notes with a length of 76 mm are classified under patterns #21 - #100. The length l of the paper notes 1 can be calculated by the photosensors P1-P4 and the clock pulse CP.

An explanation of the action in such a composition is now provided with reference to the flow chart in Figure 6.

When the paper notes 1 are conveyed by the conveyance machine without moving in a slantward direction, the paper notes 1 are detected simultaneously by the photosensors P1 and P2, and computation by the mechanical clock by means of the photointegrator 15 is started. This mechanical clock carries out the division of the paper bills into zones by means of the pulse signal CP, with this pulse signal CP being obtained the photointegrator 15 that has been provided by sandwiching a rotating plate that possesses many slits that rotate in synchronization with the driving of the conveyance machine. When it is determined by the calculation values of the CPU 20 that the forward end of the paper notes 1 has reached the magnetic sensors M1-M3, the integrator 5 starts the integration operation. After the outputs of the magnetic sensors M1-M3 are respectively amplified by the differential amplifiers, they are full wave rectified by the rectifier 3, and then provided as output to the integrator 5 via the hand pass filter 4. The waveforms AS, AF and AI of each part that are obtained by conveying the paper notes 1 in this manner are as shown for example in Figure 7 (A) through (C). The time T_0 in the same figure indicates the range of the paper notes 1. Every time the paper notes 1 proceed through a certain distance that has been set beforehand (time points t1, t2, t3, t4), the output AI of the three integrators 5 are successively converted into a digital amount DAI by the converter 7 by means of a timing signal from the CPU 20, and the values thereof 22 are memorized in the RAM 22. In other words, at time point 11, the detection data X1, X5 and X9 of the magnetic sensors M1-M3 are memorized as the data of zones #1, #5 and #9. At time point 12, the three values that are memorized are the converted values of each integrator 5, so hey are recorded anew as data X2, X6 and X10 of zones #2, #6 and #10, being data from which the detection data X1, X5 and X9 that was memorized the previous time have respectively been subtracted. Similarly, at time point 13, X3, X7 and X11 are memorized, and at time point 14, X4, X8 and X12 are memorized, respectively. As a consequence, the data X1-X4 is obtained by the magnetic sensor M1, the data X5-X8 is obtained by the magnetic sensor M2, and the detection data X9-X12 is obtained by the magnetic sensor X9-X12, respectively, and thus the detection data X1-X12 for the zones is fully obtained.

Parenthetically, it is possible to determine the length l of the paper notes by the calculation values from the mechanical clock while the paper notes 1 are being detected by means of the photosensors P1 and P2, but in this embodiment it is determined by the

mechanical clock in the period from when the front end of the paper bills 1 is detected by the photosensors P3 and P4 until when the rear end of the paper bills 1 passes through the photosensors P1 and P2. Since the distance between the photosensors P1 and P3 is known beforehand, the determination of the length l can be done with a smaller clock count, and errors can be minimized even if there are slips. At the point when the rear end of the paper bills 1 passes through the photosensors P1 and P2, the data for zones #4, #8 and #12 has still not been obtained. The amount of movement in a slantward direction is assumed to be zero in the above-described example, but in the event that the paper notes 1 are conveyed at a slant, the time when the front end of the paper notes 1 is detected by the photosensors P1 and P2 differs, and it is possible to detect the amount of slantward movement based on the mechanical clock count during the time from when the sensors on one side have detected the paper notes up to the time when the sensors on the other side detect the paper notes 1. Then, in the event that this slantward movement exceeds the tolerable value that has been set beforehand, that is, in the event that the slant is great, the discrimination operation is not performed, and it is acceptable to eject the paper notes separately or to **[illegible]** them and return them to the original position.

Additionally, discrimination is carried out even if there is a slant provided that it falls with the tolerable range, but the **[illegible]** timing of the integrated values from the magnetic sensors M1-M3 differs based on the amount of slant.

By configuring the device as described above, when the length l of the paper notes 1 is detected by the photosensors P1-P4, the type of paper note is specified in a general fashion in accordance with Figure 5. There are 20 standard patterns for each kind of paper note 1 depending on whether or not it is face up or down or it has slipped out of place, and its orientation, and pattern numbers have been applied to all of these. The initial value n1 and the final value n2 of the pattern numbers to be compared are selected by the length detection (step S2). For example, in the event that it is taken to be 80 mm based on the length detection, pattern numbers #101 - #120 are selected. Then, after the length detection, when the data for all zones is obtained as described above (step S3), the ratio of each detection value is calculated so that the total for the detection data X1-X12 of the zones #1-#12 ends up being 1. For example, a ratio is calculated by (X1 + X2 + ...+ X12) for the detection data X1 of zone #1, and x1 is obtained as the detection pattern data. In a like manner, the detection pattern data x2-x12, which shows the ratio of the zones #2 - #12, is obtained, and memorized in the RAM 22 (step S4). Next, a comparison is made of this respective pattern data xi (i = 1-12) and the data of the initial standard pattern numbers selected in step S2 (steps S5-S9). For example, the data for pattern numbers #101 is read out in the case of the old-style 5,000 yen paper note, and then first a determination is made whether or not $a1 - d1 \leq x1 \leq a1 + d1$ is satisfied. If it is OK, a comparison is next made of zone #2, and a determination is made whether or not $a2 - d2 \leq x2 \leq a2 + d2$ is satisfied. When all the zones #1 - #12 are determined to be OK by following this procedure, next the distance **[formula illegible]** (= CHD) from the mean value ai is calculated (step S10), and is compared with the effective distance ed of the pattern number #101 (step S11). Then, if CD < ed, the pattern number #101 and the value of CHD is memorized in the RAM 22 assuming that the patterns match (step S12).

Here, the distance CHD is the pattern for seeing how large the gap is between the detection pattern data xi and the mean value ai of the of the standard pattern, and the distance becomes zero provided that the detection pattern data xi in all zones matches the

mean value ai of the standard pattern. The determination in each zone is performed based on whether or not $ai - di \leq xi \leq ai + di$ is satisfied, but even if it is OK for all zones, the distance CHD of those items that just barely pass at the upper and lower limits of each zone becomes larger, and the gap with the original standard value is deemed to be large, and the paper note is expelled.

When the pattern number #101 is memorized in the above-described example, the standard pattern data of the next pattern number #102 is read out and compared (step S13, S14), and comparisons are successively performed up to pattern number #120. Then, when the comparisons of all the pattern numbers are **[illegible]**, all conditions are assumed to be OK, and a determination is made of the count of pattern numbers that have been memorized and registered (step S15), and it is determined to be a fake paper if note if it is not complete (step S16). In addition, when there is a plurality of pattern numbers comparisons are made of the values of the distance CHD, respectively, and the pattern number for the item whose value is smallest is memorized in the RAM 22 (step S16, S17), and the type of paper note, the orientation, etc., are specified for one [pattern] based on this memorized pattern number (step S18). If there is only one registered pattern number, the type of paper note, the orientation, etc., will be specified based on this number.

An explanation was provided in the foregoing of an example that employs a magnetic sensor as the detection sensor, but discrimination is equally possible with an optical sensor. In addition, in the foregoing the paper notes have been separated into zones #1-#12, but the number of divisions may be chosen as one wishes.

(Effects of the Invention)

As described above, since this invention makes it possible to compare by taking the ratios between the standard data itself with comparing the detection data as is with the standard data, there is almost no effect whatsoever due to soiling and wear and tear. In addition, since the aggregate value of the difference between the detection pattern data in each zone and the mean value of the standard pattern data is taken, and the pattern whose value is smaller is prioritized, there is the advantage that it is possible to discriminate while increasing the pass rate a large number of different kinds of paper notes without this being affected by the circumstances of the conveyance of the same.

4. Brief Description of the Figures

Figure 1 is a compositional diagram that shows one example of a device that applies the method of this invention. Figure 2 is a compositional diagram that shows one example of the magnetic sensor employed for this invention. Figure 3 (A) and (B) explain the zone divisions of this invention, respectively. Figure 4 and Figure 5 are diagrammatic tables for explaining the standard pattern of this invention, respectively. Figure 6 is a flow chart that shows an operational example of this invention. Figure 7 (A) through (C) are timing charts that show an operational example of magnetic charts.

Key

1... Paper notes
2... Differential amplifier
3... Rectifier
4... Hand pass filter

5... Integrator
6... Multiplexer
M1 – M3... Magnetic sensors
P1 – P4... Photosensors

Agent of the Patent Applicant: Takeo [?] Yasugata

Clean copy of the figures (no change in contents)

Figure 1

3... Rectifier
5... Integrator
6... Multiplexer
11, 12, 13, 14... Waveform shaping [circuits]
15... Photointegrator
16... Waveform shaping [circuit]

Figure 2

Figure 3

Figure 4

a1	Mean value of zone #1
d1	Deviation of zone #1
a2	Mean value of zone #2
d2	Deviation of zone #2
a3	Mean value of zone #3
.....	.....
a11	Mean value of zone #11
d11	Deviation of zone #11
a12	Mean value of zone #12
d12	Deviation of zone #12
ed	Effective distance

Figure 5

Length of paper	Kind of paper note	Pattern

note (mm)		number
72	500 yen (old style)	#1-20
76	1,000 yen (old style)	#21-40
	1,000 yen (new style)	#41-60
	5,000 yen (new style)	#61-80
	10,000 yen (new style)	#81-100
80	5,000 yen (old style)	#101-120
84	10,000 yen (old style)	#121-140

Figure 6

START

Step 1: Length detection

Step 2: Selection of the standard pattern number to be compared

Step 3: Was the detection data of each zone obtained?

Step 4: Calculate and memorize the ratio of the standard data

Step 5: **[illegible]**

Step 6: i ← 1

Step 7: Within the tolerable range?

Step 8: i ← I + 1

Step 9: I = 13?

Step 10: Calculate CHD

Step 11: CHD < ed

Step 12: Register pattern number and CHD

Step 13: **[illegible]**

Step 14: **[illegible]**

Step 15: Is there a registered number

Step 16: Are there multiple pattern numbers?

Step 17: Compare the CHD and memorize the smallest pattern

Step 18: Specify the type of paper note, the orientation, etc., from the pattern number

Step 19: Fake paper note

CONCLUSION

Figure 7

AMENDMENT (FORMALITY)

August 14, 1984

TO: Manabu Shiga, Patent Office Commissioner

1. Indication of the Case
   Patent Application No. 70999 (1984)
2. Title of the Invention
   A method for discriminating bank notes
3. Party Making the Amendment
   Relationship with the matter: Patent applicant
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5. Date of the Amendment Order
   July 11, 1984
   (Date sent: July 31, 1984)

6. Object of amendment

Specification and figures

[seals at right] Formality examination. Tachizawa

7. Contents of amendment

(1) To amend with a clean copy of the specification initially appended to the application as per the attachment (without changes to the contents)

(2) To amend the figures appended to this application as per the attachment